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through an angle of 180° , and it will become the vector (+1), or will be multiplied by (-1); that is, $(-1)(-1) = +1$. [F. P. Matz.]

PROBLEMS.

56. Proposed by CHAS. E. MYERS, Canton, Ohio, and Hon. JOSIAH H. DRUMMOND, LL. D., Portland, Maine.

(a), How much can be paid for a bond, bearing 5% interest and having ten years to run, so as to realize 3% on the investment? [C. E. Myers]; (b), At what price must the government sell 5% \$100 bonds to run ten years, interest payable annually, to make them the same to the buyer as 3% bonds at par, to run ten years, interest payable annually, provided the buyer can invest all interest received at 4% interest payable annually? [J. H. D.]

57. Proposed by J. C. CORBIN, Pine Bluff, Arkansas.

Find the quotient of

$$\left| \begin{array}{cccc} (s-a_1)^2 & a_1^2 & a_1^2 & \dots \dots \dots a_1^2 \\ a_2^2 & (s-a_2)^2 & a_2^2 & \dots \dots \dots a_2^2 \\ a_3^2 & a_3^2 & (s-a_3)^2 & \dots \dots \dots a_3^2 \\ \dots \dots \dots & \dots \dots \dots & \dots \dots \dots & \dots \dots \dots \\ a_n^2 & a_n^2 & a_n^2 & \dots \dots \dots s-a_n^2 \end{array} \right| \div \left| \begin{array}{cccc} s-a_1 & a_1 & a_1 & \dots \dots \dots a_1 \\ a_2 & s-a_2 & a_2 & \dots \dots \dots a_2 \\ a_3 & a_3 & s-a_3 & \dots \dots \dots a_3 \\ \dots \dots \dots & \dots \dots \dots & \dots \dots \dots & \dots \dots \dots \\ a_n & a_n & a_n & \dots \dots \dots s-a_n \end{array} \right|$$

GEOMETRY.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

45. Proposed by B. F. BURLESON, Oneida Castle, New York.

Determine the radius of a circle circumscribing three tangent circles of a radii $a=15$, $b=17$, and $c=19$.

I. Solution by the PROPOSER: J. F. W. SCHEFFER, A. M., Hagerstown, Maryland; A. H. BELL, Hillsboro, Illinois; and F. P. MATZ, M. Sc., Ph. D., Mechanicsburg, Pennsylvania.

The problem has two cases: first, when the three given circles are tangent internally to the required circle, as in the problem; and, second, when the required circle is tangent to them externally. But one solution involving the resolution of a quadratic equation, will give the answers to both cases. We give the figure for the first case only.